Thermophysical Property Measurements on Liquid Niobium and Titanium by a Microsecond-Resolution Transient Technique using High-Speed Laser Polarimetry and Pyrometry

K. Boboridis
Metallurgy Division
National Institute of Standards and Technology
Gaithersburg, MD 20899-8557 U.S.A.

A microsecond-resolution technique was used to measure heat of fusion, specific heat capacity, and electrical resistivity of liquid niobium and titanium. The method is based on rapid resistive self-heating of a wire-shaped specimen by a high-current pulse from a capacitor-discharge system. Melting of the specimen occurs in approximately 50 μs. The specimen disintegrates and the experiment is over in less than 100 μs. Due to the high heating rate of approximately 10^7 K·s^{-1} the cylindrical geometry of the specimen is preserved well into the liquid state, at temperatures several hundred degrees above the melting point. Measured quantities are the current through the specimen, the voltage drop across the specimen, the radiance temperature of the specimen, and its normal spectral emittance, as functions of time. The true specimen temperature is computed from the values of the normal spectral emittance and the radiance temperature of the specimen at each instant. The latter quantities are measured by means of high-speed laser polarimetry and optical pyrometry, respectively. The pulse-heating system used to obtain these measurements will be described. The applicability of laser polarimetry to fast resistive pulse-heating systems and the impact of initial specimen surface condition on the measurement will be discussed. The present data will be compared with data determined in the past without the use of laser polarimetry.